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ABSTRACT

To assess the effects of traditional and experimental approaches to a remedial mathematics course at Pasadena City College, data was collected on a control and experimental class of the course. The control class was taught by a teacher who was assigned the class in order to complete his teaching load; this class was taught in the traditional manner--lecture, demonstration, homework, frequent testing, and standard grading distributions. The experimental class was taught by a teacher who volunteered for the assignment and who expressed a desire to work with the remedial student; only two tests (midterms and finals) were administered and midterm grading was liberalized to provide the maximum amount of positive reinforcement and to discourage dropouts. Text material for both classes was the same, but the teacher of the experimental class also used enrichment materials suited to the abilities of the class. The results of pre- and post-tests showed that the experimental group achieved at a significantly higher level than did the control group. The results of three administrations of the Osgood Semantic Differential show that the experimental group viewed itself more positively in all three areas studied: ability in math, success in math, and feeling about math. Withdrawal rates for both classes were the same. The Osgood test is appended. (Author/DC)

# A STUDY COMPARING THE TRADITIONAL APPROACH VERSUS AN EXPERIMENTAL APPROACH TO TEACHING REMEDIAL MATH IN THE COMMUNITY COLLEGE

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A PRACTICUM PRESENTED TO NOVA UNIVERSITY
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A STUDY COMPARING THE TRADITIONAL APPROACH VERSUS AN EXPERIMENTAL APPROACH TO TEACHING REMEDIAL MATH IN THE COMMUNITY COLLEGE

## I. INTRODUCTION

The question could be raised, "Should remedial work in basic math skills fall within the scope of the community college's responsibility?" While this question is being debated in some quarters, increasing numbers of students are taking advantage of the open door policies of the community colleges and are enrolling in remedial math classes. The community colleges have reluctantly offered such courses and as a consequence have tended to implement them on a trial and error basis with scant research on their effectiveness.

## II. BACKGROUND AND SIGNIFICANCE

Pasadena City College has adopted a philosophy that recognizes that the primary responsibility for learning rests with the student, while the college encourages the enrollment of all students that may profit from the instruction offered. In keeping with this philosophy, all departments of Pasadena City College have been offering remedial classes in many areas of study. In the Business Education Department remedial math has been receiving increasing attention. This has been reflected in increased enrollments in this type of class.

It is fruitless to lay blame for the low achiever in math at the door of the elementary or secondary school teachers.

This "buck passing" does not help to solve the basic problem. The low-math achiever should be welcomed at the community college and given as much attention as any other student.

However, as in most institutions of higher education, this remedial student usually gets short changed. If he is not over-looked altogether, he will more than likely get a teacher that is not anxious to teach elementary subject matter at the community college level.

When a low achiever enrolls in a math class where the teacher adopts the traditional attitude of "sink or swim" it makes his chances of learning an up hill battle. The class room environment takes on an air of hostility instead of positive reinforcement. This student needs to recapture his dignity and needs all the reinforcement he can get. It is essential that his teacher plan his learning experiences to meet his individual needs, so that he may experience encouragement from success rather than frustration from failure.

The Chairman of the Deparpment of Business defines the problem as follows: "The student who enrolls in Business 408, Business Arithmetic, finds himself at the remedial or foundation levels so far as arithmetic skills are concerned. As he is preparing himself for one of the business occupations at the entry level, it is essential that he acquire knowledge of the fundamental process, i.e. addition, subtraction, multiplication,

and division of whole numbers, common fractions and decimal fractions. Our evaluation of his progress in the course focuses on improvement in basic skills required to handle arithmetic processes, the student's growing realization of the importance of number concepts in our daily lives, and his development of analytical tools to solve problems. Our experience with the course has shown that progress is slow and laborious. This in no way minimizes the importance we attach to the course."

## III. REVIEW OF THE LITERATURE

Ronald R. Edwards of Westfield State College of Westfield Massachusetts writing in The Journal of Educational Research in December of 1972 described a study that attempted to predict success in remedial math courses in the community college. For his sample 181 remedial students in seven public community colleges were used. Edwards made use of a regression equation in his effort to be able to predict success in remedial math. Independent variables in the regression equation were the high school math averages, standard achievement scores in math and English from the C E E B Comparative Guidance and Placement Program, an attitude toward math score, and a math interest score.

On the basis of the study Edwards concluded that success in remedial math could be predicted 71% of the time. However, Edwards qualified the results of the study for 42% of the sample

who passed the remedial math courses scored less than 43 on the test which placed them in the remedial class. His final conclusion was that students were being passed in remedial math classes without achieving the level of math competance that was expected.

Robert Rodosky of the Columbus Public Schools of Columbus, Ohio reported on a Title I project funded under the 1965 Elementary-Secondary Education Act. This Basic Math Improvement Component had the following objectives:

1) To help the underachieving math pupil make satisfactory progress toward raising his level of grade placement in math computation, concepts and application.

2) To help the underachieving math pupil develop more positive motivations toward math.

3) To help the underachieving math pupil become successful in his regular classroom work.

The math improvement met on a regular basis for 36 weeks. Pupils met in small groups of four to eight pupils for a 45 minute period per week. Students continued in their regular classes, but were referred by their math teachers for help. Seventeen Columbus Public Schools and three parochial schools participated in the program to help improve student deficiencies. No scientific data was presented as to the effectiveness of the program.

Norma Hernandez of New Mexico State University at Las Cruses, New Mexico in April, 1972 explored ideas related to

identifying differences in math instruction, if any, that should be necessary for bi-cultural (Mexican-American) students. The paper examines the nature of the culture and the nature of math and in turn hypothesized that a culture will predispose a person to learn math in a particular way. Ms. Hernandez finally recommended that time and effort be spent in reorganizing the content so as to provide a variety of curricular experiences for all students on an individual basis.

To meet the needs of many remedial students at Kendall College, Evanston, Illinois, a private two year college, Virgil Hancher, has developed a remedial program defined as a "modular system". This approach breaks down the traditional semester time frame into seven weeks periods. A student will start at a level of math where he feels most secure. When this program becomes fully developed, it will operate as a "work-shop". At that point students will be able to continually work at their own level with programmed materials, always with an instructor near by. Hancher insists that the value of the modular approach is that it eliminates the necessity of cover-ing an extensive amount of material to have your class ready for the next course. You do not subject all of the students to the same coverage. A student learns what he must do to be able to go on and is not subjected to an entire review course of 18 weeks.

Mitchell Lazarus, writing in The Educational Digest, March 1974 describes the irrational and impeditive dread of math as mathophobia. This intellectual and emotional block can occur as the result of a variety of reasons. As a mathophobe, the student then actively turns away from math and chooses courses of a non-math nature and rapidly developes a fatalistic attitude about his ability to handle math. This attitude can seriously impair his future performance. Many mathophobes are comfortable with "some" math while others detest it all.

Lazarus does not offer any dramatic suggestions on how to deal with the mathophobia, but he does enumerate some of the causes. Math is a sequential learning process and builds on itself. However, if a student misses or skips an important sequence in his math education and fails to go back and learn the material, his efforts eventually will become less productive and less satisfying. Usually at this point his attitude becomes solidified that math is not for him.

Secondly, a student may have a teacher in the lower grades who was a mathophobe. This teacher's attitude can have a very detrimental effect on the students, for the lack of enthusiasm exhibited by the teacher for math is readily transmitted to the students.

In addition to being a serious problem in education

mathophobia can be a significant handicap in ordinary adult life. Nearly every important issue of the day-ecology, inflation, poverty, education, defense, international trade, and food supplies has a strong math component. Many changes are taking place in our society today and if a person wishes to be a part of these changes or merely to observe them intelligently, math is rapidly becoming indispensable.

## IV. PROCEDURE

The following data was collected on a control and experimental class in remedial math.

Measure:

1) Raw test scores - pre and post test - using the same materials after a period of ten weeks.

2) Osgoods' Semantic Differential was administered to determine if a significant difference in attitude toward math had taken place.

3) Withdraw rates were recorded after 10 weeks

Sample: The sample was randomly selected. Both classes had the benefit of advisement by the same counselors. There was no screening or prerequisites for the classes. The classes were scheduled at convenient hours of the day, day of the week, and both classes were housed in a well lighted, air-conditioned classroom.

Procedure: The control class was taught by a teacher who was assigned the class in order to complete his teaching

load. This class was being taught in the traditional, routine manner--lecture, demonstration, homework, frequent testing, and using the standard grading distribution. The text material was the same for both classes.

The experimental class was being taught by a well qualified teacher who volunteered for the assignment and expressed a desire to work with the remedial student. In addition to using the adopted text, the teacher was using enrichment material suited to the abilities of the class. In an effort to create an atmosphere of acceptance, the class was not subjected to frequent testing but instead testing was to be held two times during the semester--mid-term and finals. Stress was placed on self evaluation. Mid-term grading was very liberal in order to provide the maximum amount of positive reinforcement thus encouraging retention and discouraging drop-outs.

The following techniques were used to verify any significant differences in the areas to be measured.

1) Achievement Difference - "t" test

2) Semantic Differential - graphic visual screening of unit differences

3) Withdraw Rates - appropriate non-parametric statistical technique

Pre-Post Test raw scores were used to determine if any significant changes had taken place between the Experimental

and the Control Groups. However the data collected by the experimenter turned out to be badly skewed. So the experimenter used the pre-post test raw score differences and chose to use the Mann-Whitney U-Test instead of the t-test as had been originally planned.

Siegel points out that the Mann-Whitney U-Test is one of the most powerful non-parametric and useful alternatives to the parametric t-test when the experimenter wishes to avoid the basic assumptions of the t-test.

## V. FINDINGS

A. Diagnostic Testing: The pre-post raw score differences were ranked in the following order. The basic formula for the Mann-Whitney U-Test is:

$$U = N_1 N_2 + \frac{N_1 (N_1+1)}{2} - R_1$$

$$U^1 = N_1 N_2 + \frac{N_2 (N_2+1)}{2} - R_2$$

Step #1 The scores were ranked in the following order:

| Experimental | Rank | Control | Rank |
|---|---|---|---|
| 58 | 22.5 | 44 | 13 |
| 58 | 22.5 | 6 | 2 |
| 29 | 6 | 40 | 10.5 |
| 56 | 21 | 48 | 17 |
| 60 | 24 | 50 | 18.5 |
| 52 | 20 | 32 | 8.5 |
| 50 | 18.5 | 28 | 5 |
| 44 | 13 | 8 | 3 |
| 63 | 25 | 5 | 1 |
| 72 | 27 | 10 | 4 |
| 70 | 26 | 32 | 8.5 |
| 44 | 13 | 40 | 10.5 |
| 46 | 16 | 30 | 7 |

Step #2 $13 \times 13 = 169$

Step #3 $\frac{(13 + 1)13}{2} = 91$

Step #4 Add rank for Exp. Group = 254.5

Step #5 $169 + 91 = 260 - 254.5 = 5.5$

Step #6 $169 - 5.5 = 163.5$

U = 5.5, Significant at .001 (one-tailed)[1]

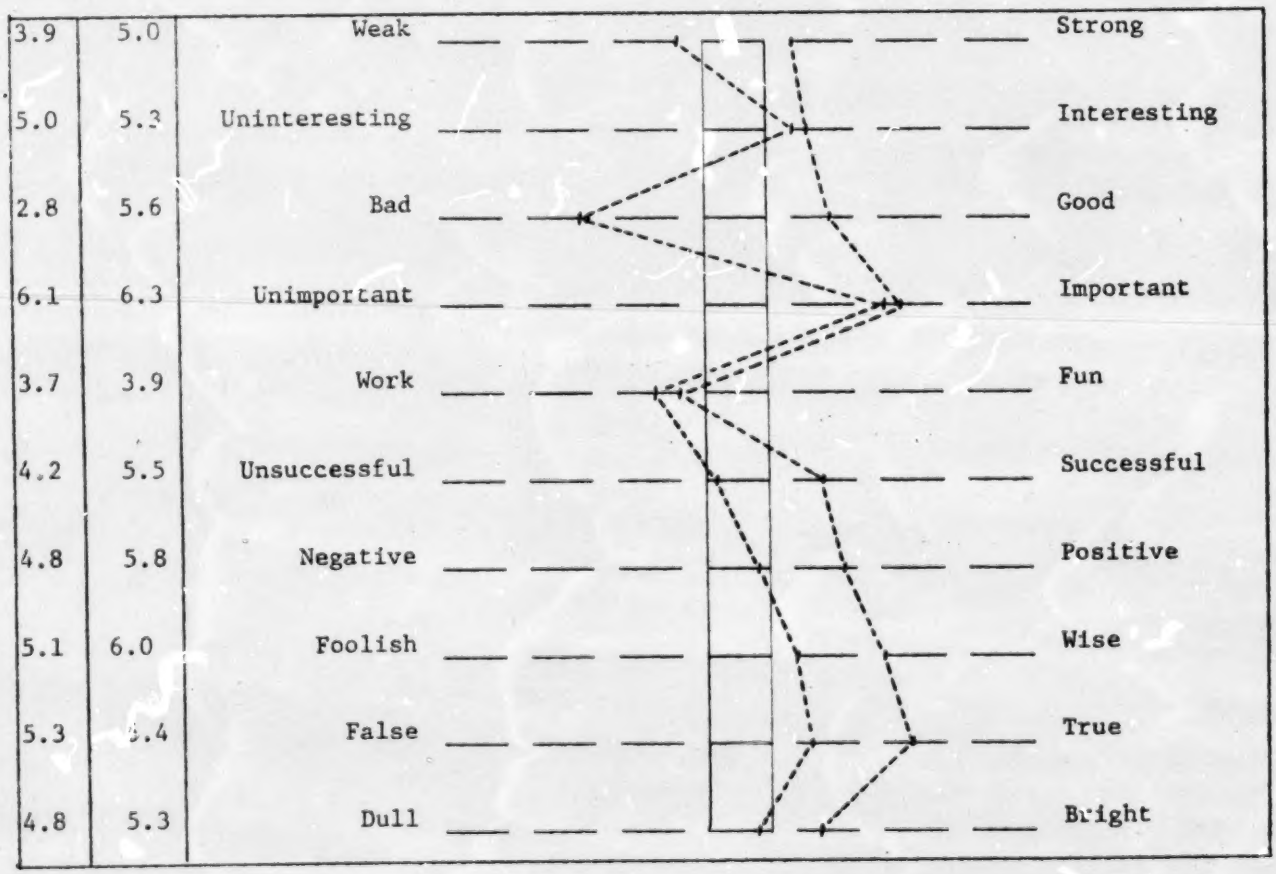
B. Semantic Differential: The figures, 1 through 5 that follow, graphically illustrate the results of Osgood's Semantic Differential which was used to determine if any significant change in attitude toward math had taken place.

[1]Bruning, J.L., Kintz, Computational Handbook of Statistics, Palo Alto, Scott, Foresman, and Company, 1968. p. 201-203, Appendix G.

Osgood's Semantic Differential was administered to determine if an observable difference in attitude toward math could be established.* The results of the test are as follows:

MY ABILITY IN MATH

Fig. 1




A - Control Group

B - Experimental Group

Math Ability:

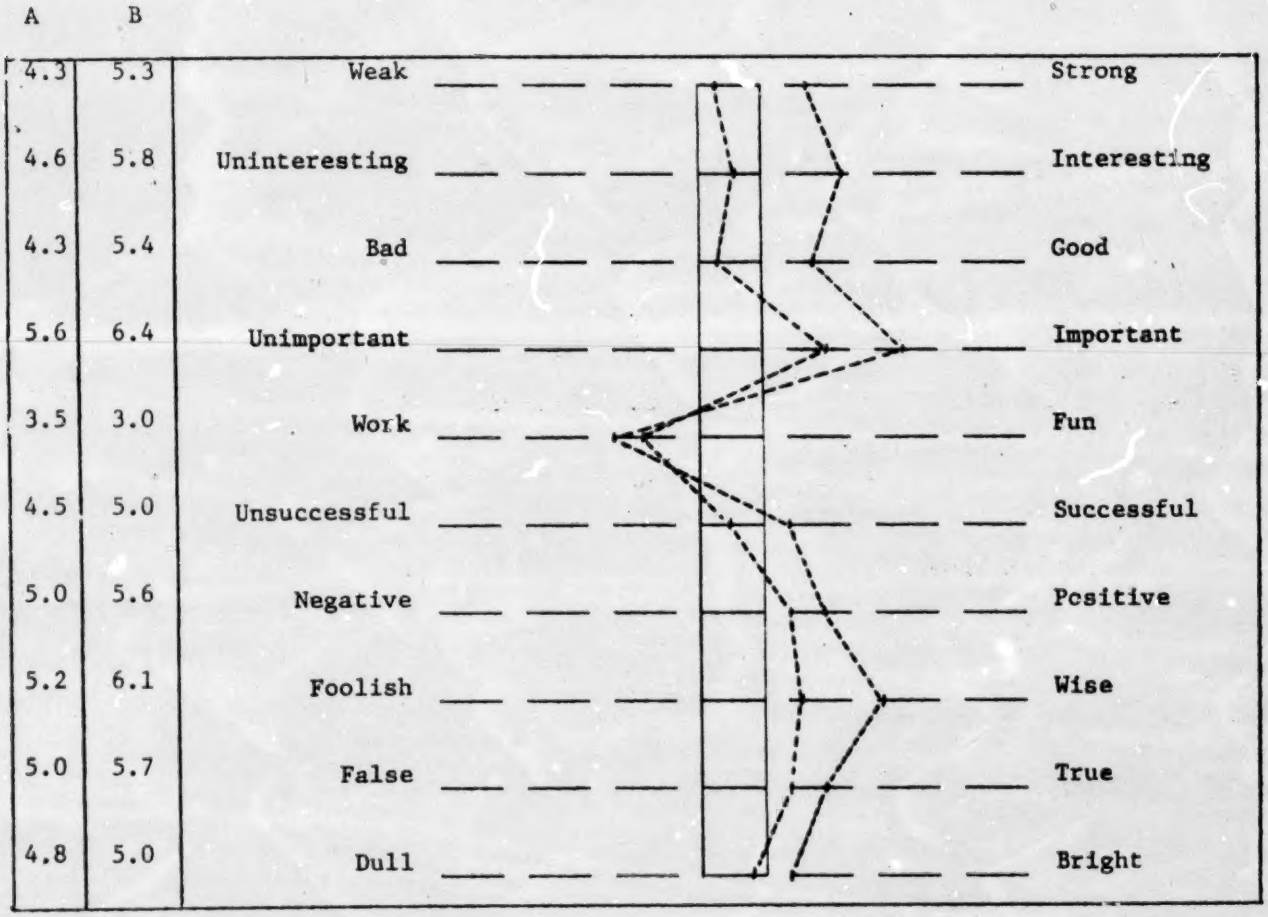
In general terms the Experimental Group saw itself as: Strong, Interesting, Good, Important, Successful, Positive, Wise, True and Bright. However, they did view math as Work.

While the Control Group saw itself as; Interesting, Important, Wise and True. At the same time they saw themselves as; Weak, Bad, and that math was Work.

* See Appendix

MY SUCCESS IN MATH

Fig. 2




A - Control Group

B - Experimental Group

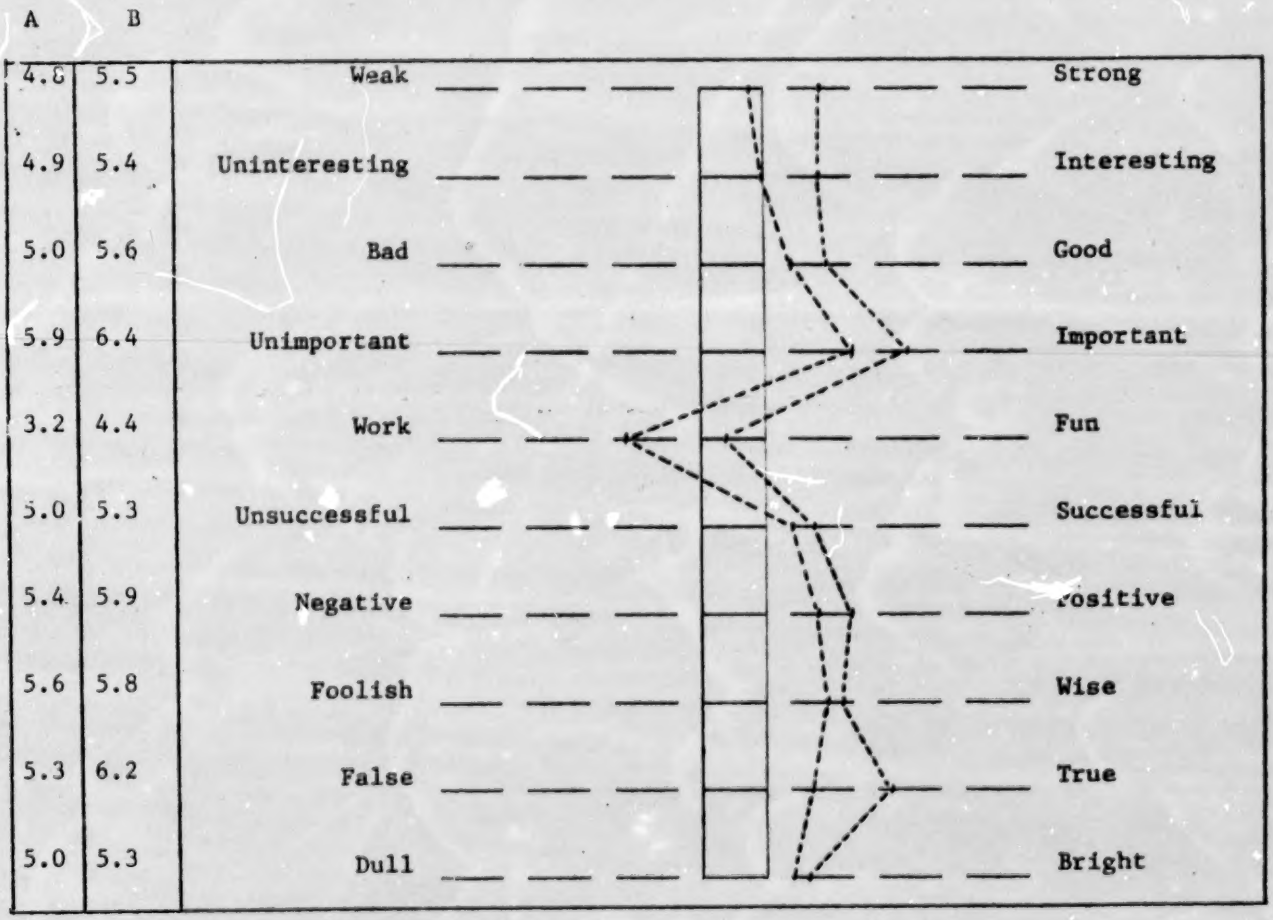
Success:

In general terms the Experimental Group saw itself as: Strong, Interesting, Good, Important, Successful, Positive, Wise, True, and Bright, but mathwas also viewed as Work.

The Control Group saw itself as: Important, Positive, Wise, and True. Also agreed with the Experimental Group and viewed math as Work.

MY FEELING ABOUT MATH

Fig. 3




A - Control Group

B - Experimental Group

Feeling:

In general terms the Experimental Group saw itself as: Strong, Interesting, Good, Important, Successful, Positive, Wise, True, and Bright.

The Control Group saw itself as: Good, Important, Successful, Positive, Wise, True, and Bright, however, math was viewed as Work.

EXPERIMENTAL

The underlined adjectives indicated how the Experimental Group rated themselves in each of the three areas that were examined.

Fig. 4

| ABILITY | SUCCESS | FEELING |
|---|---|---|
| Weak | Weak | Weak |
| <u>Strong</u> | <u>Strong</u> | <u>Strong</u> |
| Uninteresting | Uninteresting | Uninteresting |
| <u>Interesting</u> | <u>Interesting</u> | <u>Interesting</u> |
| Bad | Bad | Bad |
| <u>Good</u> | <u>Good</u> | <u>Good</u> |
| <u>Important</u> | <u>Important</u> | <u>Important</u> |
| Unimportant | Unimportant | Unimportant |
| Fun | Fun | Fun |
| <u>Work</u> | <u>Work</u> | <u>Work</u> |
| <u>Successful</u> | <u>Successful</u> | <u>Successful</u> |
| Unsuccessful | Unsuccessful | Unsuccessful |
| <u>Positive</u> | <u>Positive</u> | <u>Positive</u> |
| Negative | Negative | Negative |
| Foolish | Foolish | Foolish |
| <u>Wise</u> | <u>Wise</u> | <u>Wise</u> |
| <u>True</u> | <u>True</u> | <u>True</u> |
| False | False | False |
| Dull | Dull | Dull |
| <u>Bright</u> | <u>Bright</u> | <u>Bright</u> |

CONTROL

The underlined adjectives indicated how the Control Group rated themselves in each of the three areas that were examined.

Fig. 5

| ABILITY | SUCCESS | FEELING |
|---|---|---|
| <u>Weak</u> | Weak | Weak |
| Strong | Strong | Strong |
| <u>Interesting</u> | Interesting | Interesting |
| Uninteresting | Uninteresting | Uninteresting |
| <u>Bad</u> | Bad | Bad |
| Good | Good | <u>Good</u> |
| <u>Important</u> | <u>Important</u> | <u>Important</u> |
| Unimportant | Unimportant | Unimportant |
| Fun | <u>Fun</u> | Fun |
| <u>Work</u> | <u>Work</u> | Work |
| Successful | Successful | <u>Successful</u> |
| Unsuccessful | Unsuccessful | Unsuccessful |
| Positive | <u>Positive</u> | <u>Positive</u> |
| Negative | Negative | Negative |
| Foolish | Foolish | Foolish |
| <u>Wise</u> | <u>Wise</u> | <u>Wise</u> |
| <u>True</u> | <u>True</u> | <u>True</u> |
| False | False | False |
| Dull | Dull | Dull |
| Bright | Bright | <u>Bright</u> |

1. Significant Difference Between Groups (1.0 diff.)

For the purposes of this study, the following recommendations advanced by Nelson have been accepted. As a rule of thumb, any score that is over one scale unit (1.0) in difference becomes significant.[2]

| My Ability In Math: | E | C | Diff. |
|---|---|---|---|
| Strong - E | 5.0 | 3.9 | 1.1 |
| Good - E | 5.6 | 2.8 | 2.8 |
| Successful - E | 5.5 | 4.2 | 1.3 |
| Positive - E | 5.8 | 4.8 | 1.0 |
| True - E | 6.4 | 5.3 | 1.1 |
| **My Success In Math:** | | | |
| Strong - E | 5.3 | 4.3 | 1.0 |
| Interesting - E | 5.8 | 4.6 | 1.2 |
| Good - E | 5.4 | 4.3 | 1.1 |

C. With-Drawal Rate: The withdrawal rates from the Experimental and the Control class in remedial math was recorded after a 10 week period - (Sept. 15-Dec. 1). Chi-Square was used to determine the degree of relationship between the two withdrawal rates.

[2]Nelson, Ronald C. "A Manual For Use With The Semantic Differential", unpublished Masters project, University of Southern California, 1964.

| | Control | Experimental |
|---|---|---|
| enrollment | A | B |
| Sept. 15 | 32 | 26 |
| Drops | C | D |
| Dec. 1 | 16 | 10 |

$$X^2 = \frac{N(AD-BC)^2}{(A+B)\ (C+D)\ (A+C)\ (B+D)}$$

$X^2 = .236$

The chi-square statistical tables indicate that the difference in the drop-out rates of the two classes were not significantly related.

## VI. DISCUSSION OF FINDINGS

The findings are discussed under the three basic areas in the study.

A. Diagnostic Testing: As noted in the findings, the pre-post raw score differences between the Experimental and Control groups were statistically significant. While the number of students remaining in the study was small, the differences between the groups were pronounced and favored the Experimental group. Thus it reasonably can be concluded that the Experimental group achieved at a significantly higher degree on the diagnostic math test than did the Control group.

B. Semantic Differential: A visual review of Figures 1, 2, 3 indicates that in general the Experimental group viewed itself more positively on the adjective scales than did the Control group. The tendency toward a more positive rating was observed on all three areas studied: Ability in math, Success in math, and Feeling about math. The scale unit differences favoring the Experimental group were most evident on the measures of Ability in math. It is recognized that it is difficult to effect changes in attitude within a short period of time. Nevertheless, the general tendency of the Experimental group to rate themselves more positively seems to indicate that the experiences within the pilot program did influence the students' attitudes.

C. Withdrawal Rate: The statistical technique used to determine the degree of difference between the Experimental and Control groups in the withdrawal rate showed that there was no significant difference between the groups on this measure. There are so many extraneous factors that can affect the withdrawal rate that the lack of a significant difference was not surprising.

## VII. SUMMARY-CONCLUSIONS-RECOMMENDATIONS

Summary: The teaching of remedial math in the Business Department at Pasadena City College has been carried on without

any attempt to evaluate the degree of success. This pilot study is the first attempt to evaluate the method of assigning teachers and the techniques used by the teachers to improve the achievement level and attitudes of the students enrolled in remedial math.

The study involved two remedial classes, one an Experimental and the other a Control class. The Experimental class was subjected to a new approach while the Control class was taught in the traditional manner with frequent tests, lecture, demonstrations, home work, etc.

The findings on the pre-post tests showed that the Experimental group achieved at a significantly higher level than the Control group.

Findings on the Scales used to measure attitudes toward math favored the Experimental group. The strongest positive attitudes were on the scale that measured Ability in math. There seemed to be no significant difference between the two groups on the rates of withdrawal from their respective classes.

Conclusion: Considering the pilot nature and the limitations of the study the results were very encouraging. The significance in the results favoring the teaching approach used with the Experimental group would warrant further investigation.

Recommendations:

1) Teachers should be assigned to teach remedial math classes on a voluntary basis. This recommendation was implemented for the Spring semester.

2) The findings of this study strongly indicate that a more comprehensive study be undertaken to confirm the results of this pilot project. A study of this nature will be undertaken by the Department of Business in the Fall of 1975.

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PASADENA CITY COLLEGE

OSGOOD'S SEMANTIC DIFFERENTIAL

Words often have different meaning as interpreted by various persons. The following are several topics, each with a set of opposite adjectives. You are to rate the topics on each of the adjectives. Rate on the basis of what it means to you.

For example if what you are judging is very close to the end of the scale then you indicate this as follows - Example

MY DOG

UGLY ___: ___: ___: ___: ___: ___: _X_: BEAUTIFUL

If it is closer to one end of the scale than the other, then rate it like this -

MY DOG

UGLY ___: ___: ___: ___: ___: _X_: ___: BEAUTIFUL

OR - if not that close then -

MY DOG

UGLY ___: ___: ___: ___: _X_: ___: ___: BEAUTIFUL

If the scale has nothing to do with what you are judging or if your judgment is neutral, then rate as follows -

MY DOG

UGLY ___: ___: ___: _X_: ___: ___: ___: BEAUTIFUL

Please complete each scale under each topic. Place your mark in the center of the space. Do no spend too much time on any item and be sure to judge each item separately.

Name_____ Date_____

Words often have different meaning as interpreted by various persons. The following are several topics. Each followed with a set of opposite adjectives. You are to rate the topics on each of the adjectives. Rate on the basis of what it means to you.

MY ABILITY IN MATH

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| WEAK | ___: | ___: | ___: | ___: | ___: | ___: | ___: STRONG |
| INTERESTING | ___: | ___: | ___: | ___: | ___: | ___: | ___: UNINTERESTING |
| GOOD | ___: | ___: | ___: | ___: | ___: | ___: | ___: BAD |
| UNIMPORTANT | ___: | ___: | ___: | ___: | ___: | ___: | ___: IMPORTANT |
| FUN | ___: | ___: | ___: | ___: | ___: | ___: | ___: WORK |
| SUCCESSFUL | ___: | ___: | ___: | ___: | ___: | ___: | ___: UNSUCCESSFUL |
| POSITIVE | ___: | ___: | ___: | ___: | ___: | ___: | ___: NEGATIVE |
| FOOLISH | ___: | ___: | ___: | ___: | ___: | ___: | ___: WISE |
| TRUE | ___: | ___: | ___: | ___: | ___: | ___: | ___: FALSE |
| DULL | ___: | ___: | ___: | ___: | ___: | ___: | ___: BRIGHT |

Name_____ Date_____

Words often have different meaning as interpreted by various persons. The following are several topics. Each followed with a set of opposite adjectives. You are to rate the topics on each of the adjectives. Rate on the basis of what it means to you.

MY SUCCESS IN MATH

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| WEAK | ___: | ___: | ___: | ___: | ___: | ___: | ___: | STRONG |
| INTERESTING | ___: | ___: | ___: | ___: | ___: | ___: | ___: | UNINTERESTING |
| GOOD | ___: | ___: | ___: | ___: | ___: | ___: | ___: | BAD |
| UNIMPORTANT | ___: | ___: | ___: | ___: | ___: | ___: | ___: | IMPORTANT |
| FUN | ___: | ___: | ___: | ___: | ___: | ___: | ___: | WORK |
| SUCCESSFUL | ___: | ___: | ___: | ___: | ___: | ___: | ___: | UNSUCCESSFUL |
| POSITIVE | ___: | ___: | ___: | ___: | ___: | ___: | ___: | NEGATIVE |
| FOOLISH | ___: | ___: | ___: | ___: | ___: | ___: | ___: | WISE |
| TRUE | ___: | ___: | ___: | ___: | ___: | ___: | ___: | FALSE |
| DULL | ___: | ___: | ___: | ___: | ___: | ___: | ___: | BRIGHT |

Name_ _____ Date_____

Words often have different meaning as interpreted by various persons. The following are several topics. Each followed with a set of opposite adjectives. You are to rate the topics on each of the adjectives. Rate on the basis of what it means to you.

MY FEELING ABOUT MATH

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| WEAK | ___: | ___: | ___: | ___: | ___: | ___: | ___: | STRONG |
| INTERESTING | ___: | ___: | ___: | ___: | ___: | ___: | ___: | UNINTERESTING |
| GOOD | ___: | ___: | ___: | ___: | ___: | ___: | ___: | BAD |
| UNIMPORTANT | ___: | ___: | ___: | ___: | ___: | ___: | ___: | IMPORTANT |
| FUN | ___: | ___: | ___: | ___: | ___: | ___: | ___: | WORK |
| SUCCESSFUL | ___: | ___: | ___: | ___: | ___: | ___: | ___: | UNSUCCESSFUL |
| POSITIVE | ___: | ___: | ___: | ___: | ___: | ___: | ___: | NEGATIVE |
| FOOLISH | ___: | ___: | ___: | ___: | ___: | ___: | ___: | WISE |
| TRUE | ___: | ___: | ___: | ___: | ___: | ___: | ___: | FALSE |
| DULL | ___: | ___: | ___: | ___: | ___: | ___: | ___: | BRIGHT |

My last math class _____ Date_____ Grade_____

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